

**REMARKS**

In the present Amendment, Claim 1 has been amended to recite that the reaction temperature is 20 to 500 °C, that the reaction pressure is 0.1 to 20 MPa, and that the amount of hydrogen is 1.0 to 30 times by mole per the olefin to be supplied. Section 112 support for the amendment is found, for example, at page 2, lines 20-23 and page 3, lines 2-3 of the specification. No new matter has been added, and entry of the Amendment is respectfully requested.

Claims 1-4 are pending.

At page 2 of the Action, Claims 1-4 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Codignola (US 3,127,452).

Applicants submit that this rejection should be withdrawn because Codignola does not disclose or render obvious the presently claimed process for hydrogenating an olefin.

Codignola is cited as disclosing a process for hydrogenating styrene by passing upwardly a liquid containing alpha-methylstyrene and a gas containing hydrogen through a packed bed of a solid hydrogenation catalyst.

The Examiner acknowledges that Codignola does not disclose: (1) how much the superficial velocity of hydrogen gas is when it passes upwardly the catalyst bed; and (2) the size of the catalyst.

However, the Examiner considers superficial velocity of hydrogen gas and the size of the catalyst to be parameters of the chemical process and that it would have been obvious to have modified Codignola process by selecting appropriate superficial velocities and the size of the catalyst to arrive at Applicants' claimed process except that unexpected results can be demonstrated.

As the Examiner admits, Codignola does not disclose: (1) how much the superficial velocity of hydrogen gas is when it passes upwardly the catalyst bed; and (2) the size of the catalyst.

The essential feature of the present invention is in the superficial velocity of the gas containing hydrogen, and the flow direction of the gas containing hydrogen and the liquid containing an olefin through a solid hydrogenation catalyst bed.

In the present invention, the hydrogenation is carried out under the specific conditions (i.e., upward flow direction, superficial velocity of hydrogen gas, catalyst size, reaction temperature, reaction pressure, and amount of hydrogen per olefin) as recited in Claim 1.

The comparison of the present invention with that of Codignola is show below.

	<u>Present Invention</u>	<u>Codignola</u>	
		<u>Example 1</u>	<u>Example 2</u>
Flow Direction	Upflow	Upflow	Downflow
Scale	Industrial	Lab	Industrial
Superficial velocity of gas	3.0 to 10 cm/sec	0.48 to 0.7 cm/sec	15 cm/sec

The superficial velocities of the Codignola's Examples in the above Table are calculated as shown in the Amendment filed September 27, 2007.

Superficial velocity of gas is a numerical value calculated by the following procedure.  
Here, the equation of state of ideal gas is used to calculate and explain easily.

$$R = \text{gas constant} = 8.314 \text{ [J/(mol}\cdot\text{K)]} = [\text{m}^3\cdot\text{Pa}/(\text{mol}\cdot\text{K})]$$

$$S = \text{cross-sectional area of reactor [m}^2\text{]}$$

$$T = \text{temperature [}^\circ\text{C]} = T + 273 \text{ [K]}$$

$P$  = pressure [kPaA]

$v$  = normal volume velocity of gas per unit time [ $\text{N m}^3/\text{h}$ ]

$N$  = mole of passed gas per unit time [ $\text{kmol}/\text{h}$ ]

$=v/22.4$

$V$  = real volume velocity of gas per unit time [ $\text{m}^3/\text{h}$ ]

$= (N \cdot R \cdot (T + 273)) / P$

$u$  = superficial velocity of gas [ $\text{m}/\text{h}$ ]  $= V/S \times 100/3600$  [ $\text{cm}/\text{s}$ ]

That is, the superficial velocity of gas is determined by the cross-sectional area of reactor, reaction temperature, reaction pressure, and mole of passed gas per unit time. Accordingly, in the definition of the superficial velocity of gas, the reaction temperature, reaction pressure, and mole of passed gas per unit time are variables.

The superior effects of the present invention, such as, uniform flow of the liquid without localization in the packed bed, low pressure loss of the packed bed, and little formation of tar caused by olefin dimer formation and olefin polymer formation, can be attained by controlling the superficial velocity of gas to 3.0 to 10 cm/sec, and flowing the liquid and gas upwardly, and under the reaction conditions recited in Claim 1.

The superior effects provided by the present invention is evidenced by Examples of the specification as shown below.

When the superficial velocity of the gas was 7 cm/sec and 6.5 cm/sec within the claimed range, the reaction amount of  $\alpha$ -methyl styrene was 49 kmol/ $\text{m}^3$  catalyst/hr and 71 kmol/ $\text{m}^3$  catalyst/hr, respectively, as shown in Examples 1 and 2. On the other hand, when the superficial velocity of the gas was 2.7 cm/sec and 2.8 cm/sec, i.e., outside the claimed range, the reaction

amount of  $\alpha$ -methyl styrene was  $14 \text{ kmol/m}^3$  catalyst/hr and  $42 \text{ kmol/m}^3$  catalyst/hr, respectively, as shown in Comparative Examples 1 and 2.

Thus, the present invention provides an industrially excellent process for hydrogenating olefin.

As already explained in Applicants' previous responses, the examples disclosed by Codignola are clearly outside the scope of the present invention. In Example 1 of Codignola, the liquid and gas flow upwardly, but the superficial velocity of gas is far lower than the claimed range of 3.0 to 10 cm/sec. In Example 2 of Codignola, the liquid and gas flow downwardly, which is completely reverse direction of the hydrogenation process of the present invention.

Accordingly, Codignola neither teach nor suggest the hydrogenation process wherein the liquid and gas are flown in upward direction and the superficial velocity of gas of 3.0-10 cm/sec. Of course, Codignola does not teach or suggest the unexpectedly superior results provided by the present invention.

Therefore, the present invention is not obvious over Codignola. Reconsideration and withdrawal of the §103(a) rejection based on Codignola are respectfully requested.

Allowance is respectfully requested. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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**23373**

CUSTOMER NUMBER

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